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DECEW FALLS GS
MEASURING WEIR
CONCRETE CONDITION SURVEY

Report No. 89-174-K

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ABSTRACT

A survey was carried out to assess the condition of the concrete in the Decew Falls GS Measuring Weir. The survey consisted of drilling concrete cores from selected areas and the visual inspection of the structure. Based on the visual assessment and physical testing of the cores, the concrete in the east abutment wall appears to be of good quality, while that in the centre pier is extensively cracked to a depth of at least 1290 mm from the top of the deck. Of concern, however, are the cracks observed in the abutment walls. Cracking of the deck was also noted, particularly in a zone 40 to 130 mm below the top surface. Because of the fast flowing water, some sections of the structure were unaccessible. It is therefore recommended that an inspection be made of the abutment walls and the centre pier at and below the waterline. The underside of the deck should also be inspected at the same time.

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DECEW FALLS GS
MEASURING WEIR
CONCRETE CONDITION SURVEY

1.0 INTRODUCTION

As requested by Mr. S.L. Forndron of the Civil Maintenance Department, a survey to determine the condition of the concrete in the Decew Falls GS Measuring Weir was conducted by the Concrete Technology Section, Civil Research Department. The survey included the drilling of concrete cores to assess the condition of the concrete in the structure and to provide specimens for laboratory testing. Visual observations were also made to determine the extent of concrete deterioration. The field work, consisting of the drilling and visual assessment, was carried out on May 11, 1989.

The results of the concrete condition survey, including the laboratory testing of specimens, are summarized in this report.

2.0 CONCRETE CORING

The concrete coring was conducted with an electric drill using a nominal 100 mm diameter diamond bit. A sketch of the structure, showing the core locations, is given in Figure 1. Six cores were drilled as follows: one from the centre pier (Core MW1), one from the east abutment wall (Core MW2), two from the deck (Cores MW4 and MW6), and two (Cores MW3 and MW5) through the deck into the west abutment wall. The two cores drilled into the west abutment wall were terminated below the deck when vertical reinforcing steel was encountered in the wall. All cores were drilled vertically. A concrete core log is given in Appendix A.

From the concrete cores, specimens were selected for laboratory testing to determine the physical properties of the concrete. The results of the compressive strength (ASTM C 42), density, and absorption (ASTM C 642) tests are given in Table 1. The compressive strength and density tests were carried out on specimens which had been saturated for 48 hours at 23°C.

3.0 OBSERVATIONS AND DISCUSSION

During the visual assessment, access to some sections of the structure was restricted due to the fast flowing water over the weir (Figures 2 and 3). This prevented detailed examination of the abutment walls, the centre pier and the underside of the deck.

The east abutment wall (Figure 4) is cracked beneath the deck and appears to be spalled at the waterline. Cracks with efflorescence are also present in the upstream portion of the wall. Core MW2, which was drilled into the abutment wall, represents good quality concrete. It should also be noted that based on the difficulty of drilling, this concrete appeared much harder than that in the centre pier. The compressive strength and the average density and absorption of specimens from this core were 57.2 MPa (one test), 2350 kg/m^3 and 5.5%, respectively.

The west abutment wall (Figure 5) exhibited similar cracking and deterioration at the waterline as that observed in the east wall. In addition, a large vertical crack is present in the wall under the deck.

In the centre pier, the concrete is cracked and spalled, particularly at the downstream end (Figure 4). Cracks were also observed in the east and west faces of the pier, and exposed vertical and horizontal reinforcing steel is present on the downstream end and the east face. The concrete in Core MW1 is randomly cracked to the full depth drilled (1290 mm). The average compressive strength, density, and absorption of the test specimens from this core were 25.5 MPa, 2317 kg/m^3, and 8.2%, respectively. The high absorption may be due to the specimens being cracked.

The cores drilled from the deck reveal that several lifts of concrete were used, ranging in thickness from 25 to 100 mm (Figure 6). The lifts are generally well bonded; however, cracking of the concrete was noted in several of the cores between 40 and 130 mm from the top surface. The steel encountered in the cores appears to be in good condition. Horizontal reinforcing steel is exposed on the upstream side of the deck (Figure 2). Because of the water conditions, a detailed inspection of the underside of the deck could not be carried out, although, from a distance, extensive deterioration was not observed.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 The concrete in the east abutment wall appears to be of good quality, based on the results of laboratory tests and the visual appearance of the concrete in the one core drilled from this wall. Of concern, however, is the cracking and spalling observed in both abutment walls. Because of restricted access, an extensive inspection of the walls could not be made.

4.2 Although the concrete in the centre pier, when tested in the laboratory, had an average compressive strength of 25.5 MPa, the presence of cracking along the full length of the core makes the quality of this concrete suspect.

4.3 The concrete cores from the deck identified the presence of a zone of cracked concrete extending from approximately 40 to 130 mm from the top surface. It is recommended that the structural significance of this cracked zone be assessed.

4.5 It is also recommended that a detailed inspection be made of the abutment walls and centre pier, particularly at and below the waterline, where the most severe deterioration is anticipated. At the same time, the underside of the deck should also be inspected.

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TABLE 1

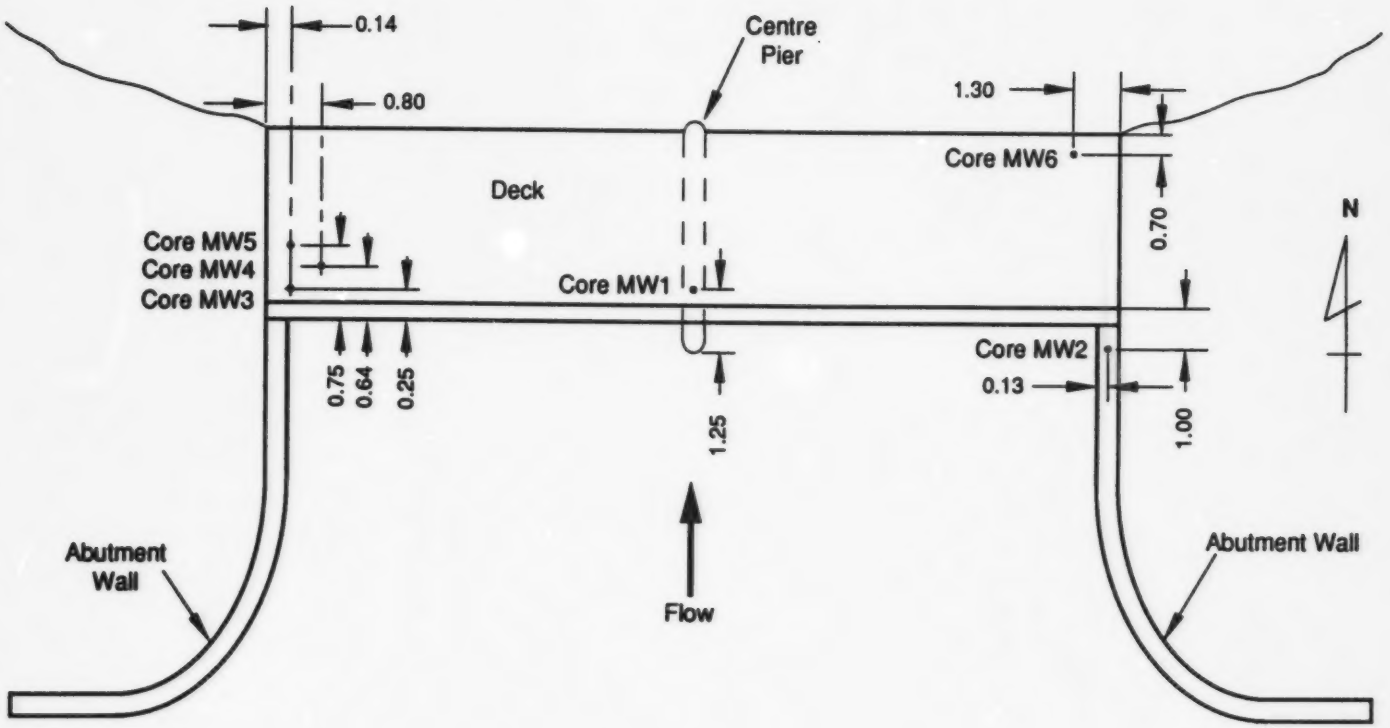
DECEW FALLS GS
MEASURING WEIR
LABORATORY TEST RESULTS OF CONCRETE CORES

Core Number	Specimen Number	Length of Test Specimen* (mm)	Compressive Strength** (MPa)	Density** (kg/m^3)	Absorption 48-Hour Immersion (%)	Remarks***
MW 1	1-2	200	-	2298	8.0	Cracks in specimen.
	1-3B	201	23.0	2337	-	Cracks in specimen.
	1-4B	200	25.8	2331	-	Cracks in specimen.
	1-5B	201	27.6	2324	-	Cracks in specimen.
	1-5C	80	-	2293	8.3	Cracks in specimen.
MW 2	2-1B	200	43.2	2342	-	Steel bar, 9 mm diameter, through specimen (use test results as a guide only).
	2-2A	90	-	2345	6.2	
	2-2B	200	57.2	2341	-	
	2-3C	62	-	2370	4.7	
MW 3	3-1	80	-	2291	6.7	One crack in specimen.
	3-2B	60	-	2344	6.7	Cracks in specimen.
MW 4	4-2	110	-	2344	6.1	
MW 5	5-1A	130	-	2318	7.5	Cracks in specimen.
MW 6	6-4	70	-	2332	6.8	

* Specimen diameter 100 mm.

** Specimens tested in a saturated state.

***Except as noted, no unusual features were observed in the test specimens.



Note

1) All dimensions are approximate and are given in metres

FIGURE 1

DECEW FALLS GS
MEASURING WEIR
LOCATION OF DRILL HOLES

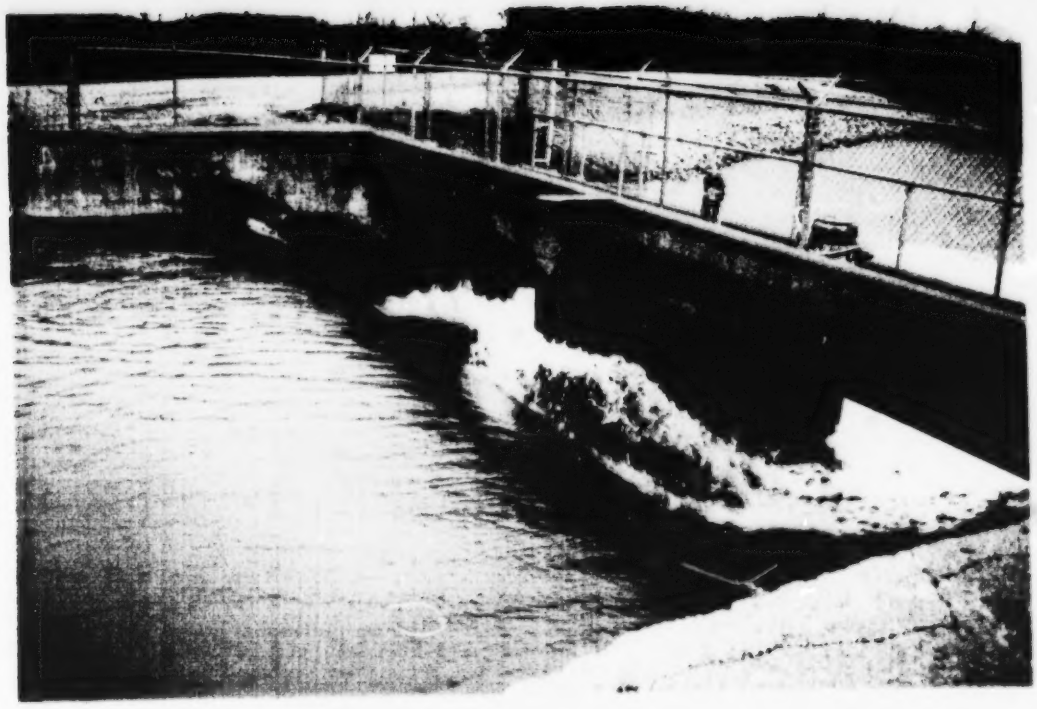


Figure 2 Upstream view of the measuring weir, looking from the east abutment wall. Note the exposed horizontal steel in the deck and centre pier.

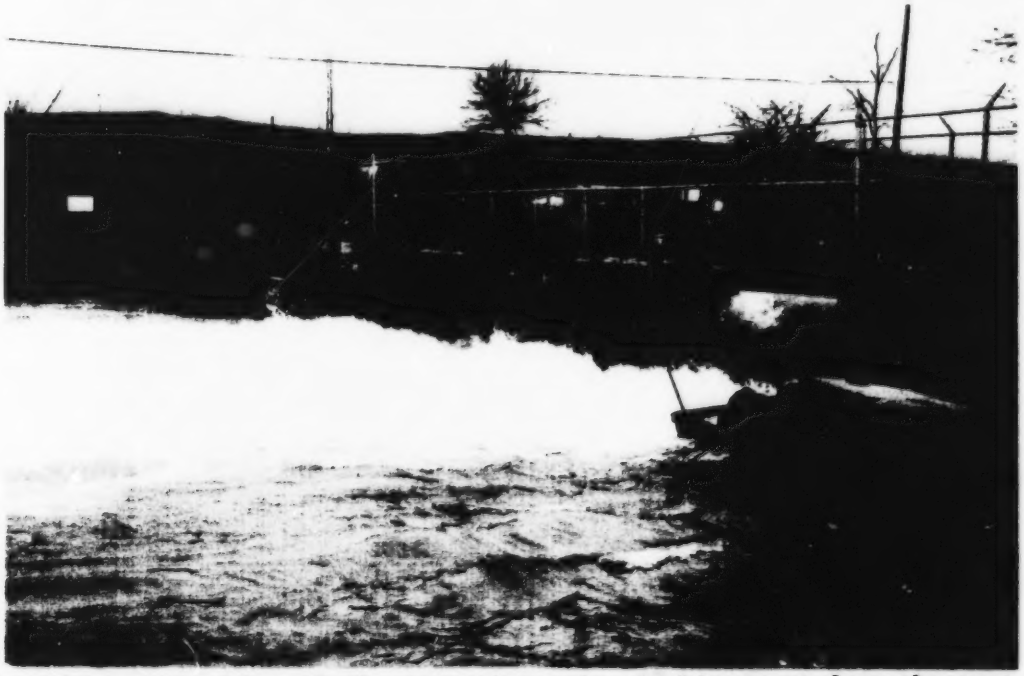


Figure 3 Downstream view of the measuring weir, looking east from the west bank.

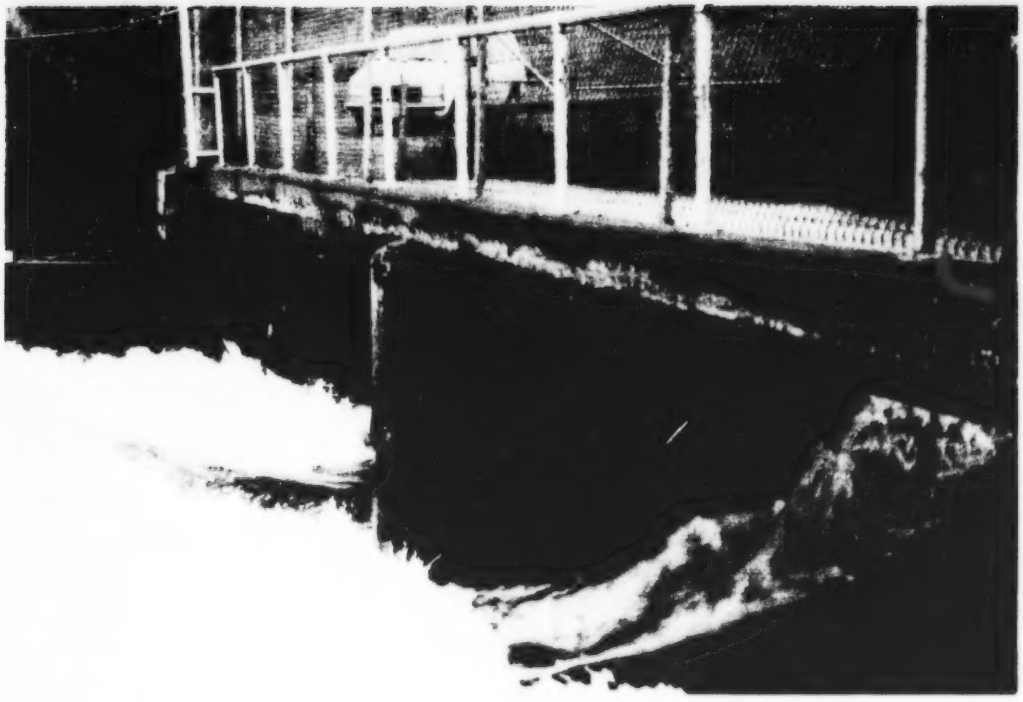


Figure 4 Downstream view of the east abutment wall and centre pier. Note the cracking of the abutment wall and the exposed vertical reinforcing steel in the pier.

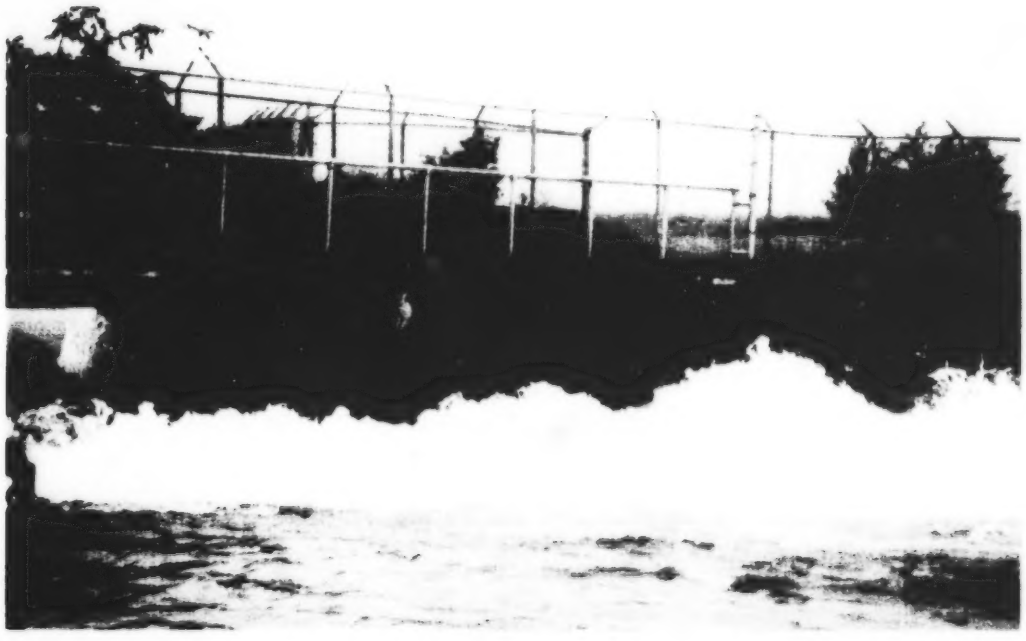


Figure 5 Downstream view of the west abutment wall and centre pier. Note the large crack in the abutment wall.

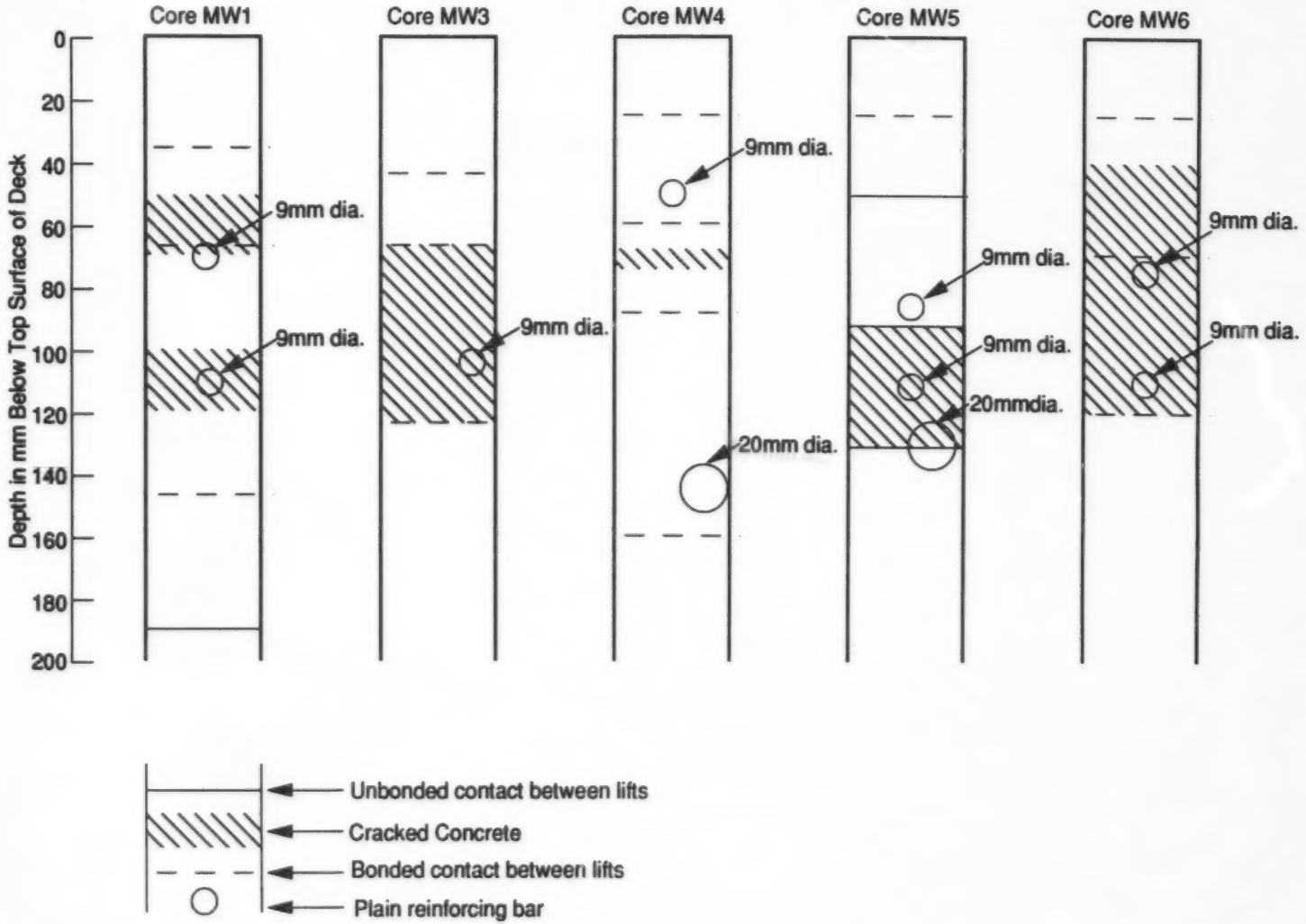


FIGURE 6
DECEW FALLS GS
MEASURING WEIR - DECK
DESCRIPTION OF CONCRETE CORES

APPENDIX A

DECEW FALLS GS
MEASURING WEIR
CONCRETE CORE LOG

APPENDIX A

DECEW FALLS GS
MEASURING WEIR
CONCRETE CORE LOG

Core Number & Location (See Figure 1)	Section I.D.	Depth in Core Hole (mm)	Remarks
Core MW1			
- Upstream end of centre pier (Figure A1)	MW1-1	0- 190	Reinforcing steel (9 mm diameter) at 70 and 110 mm.
	MW1-2	190- 400	
	MW1-3	400- 710	
	MW1-4	710- 990	
	MW1-5	990-1290	

General
- Core drilled vertically from area of good quality concrete (ie, no cracking or spalling of concrete).
- Joints in core at 35, 65, 145 and 190 mm.
- Aggregate consists of small rounded particles (nominal maximum size 15 mm), including a few large particles (50 mm) well distributed through the concrete.
- Core breaks occur through aggregates.
- Horizontal cracking in the core from 50 to 70 mm and from 100 to 120 mm.
- Random cracking in the core from 190 to 1290 mm.

Core MW2			
- East abutment wall (Figure A1)	MW2-1	0-280	Reinforcing steel (9 mm diameter) at 100 and 740 mm.
	MW2-2	280-590	
	MW2-3	590-850	

General
- Core drilled vertically from area of good quality concrete (ie, no cracking or spalling of concrete).
- Joints in core at 50 and 145 mm.
- Aggregate consists of small rounded particles (nominal maximum size 15 mm), including a few large particles (50 mm) well distributed through the concrete.
- Core breaks occur through aggregates.
- Horizontal cracks in core at 100 and 340 mm.
- Concrete harder and more difficult to drill relative to the other cores.

DECEW FALLS GS
MEASURING WEIR
CONCRETE CORE LOG

Core Number & Location (See Figure 1)	Section I.D.	Depth in Core Hole (mm)	Remarks
Core MW3			
- West end of deck into abutment wall (Figure A1)	MW3-1	0-80	Reinforcing steel (9 mm diameter) at 100 mm.
	MW3-2	80-180	
	-	180-340	Core recovered as rubble. Vertical reinforcing steel was encountered and hole was abandoned.

General
- Core drilled vertically from area of fair quality concrete (ie, some surface scaling of concrete).
- Joints in core at 45, 65 and 125 mm.
- Aggregate consists of small rounded particles (nominal maximum size 15 mm), well distributed through the concrete.
- Core breaks occur through aggregates.
- Cracking in core from 65 to 125 mm.

Core MW4			
- West end of deck (Figure A1)	MW4-1	0-120	Reinforcing steel at 50 mm (9 mm diameter) and 120 mm (20 mm diameter).
	MW4-2	120-270	

General
- Core drilled vertically into deck slab from area of good quality concrete (ie, no cracking or spalling of concrete).
- Joints in concrete at 25, 60, 90 and 160 mm.
- Aggregate consists of small rounded particles (nominal maximum size 15 mm), including a few large particles (50 mm) well distributed through the concrete.
- Core break occurs through a large 50 mm friable aggregate particle.
- Crack in core at 70 mm.

DECEW FALLS GS
MEASURING WEIR
CONCRETE CORE LOG

Core MW5			
- West end of deck into abutment wall (Figure A1)	MW5-1	0-50	Reinforcing steel at 80 mm (9 mm diameter) and 120 mm (20 mm diameter).
	MW5-2	50-90	
	MW5-3	90-130	
	MW5-4	130-180	
	-	180-500	Core recovered as rubble. Intersected vertical construction joint and vertical reinforcing steel; therefore, hole was abandoned.

General
- Core drilled vertically into deck slab from area of fair quality concrete (ie, some surface scaling of concrete).
- Joints in concrete at 25, 50 and 90 mm.
- Aggregate consists of small, rounded particles (nominal maximum size 15 mm). Top layer contains 5 mm course aggregate.
- Core breaks occur along joints or through aggregates.
- Cracking of core from 90 to 130 mm.

Core MW6			
- East end of deck (Figure A1)	MW6-1	0-50	Reinforcing steel (9 mm diameter) at 80 and 110 mm.
	MW6-2	50-100	
	MW6-3	100-160	
	MW6-4	160-240	

General
- Core drilled vertically into deck slab from area of good quality concrete (ie, no cracking or spalling of concrete).
- Joints at 25, 70 and 120 mm.
- Aggregate consists of small rounded particles (nominal maximum 15 mm).
- Core breaks occur along joints or through aggregates.
- Cracking of core from 50 to 120 mm.
- White deposits noted around some aggregate particles.

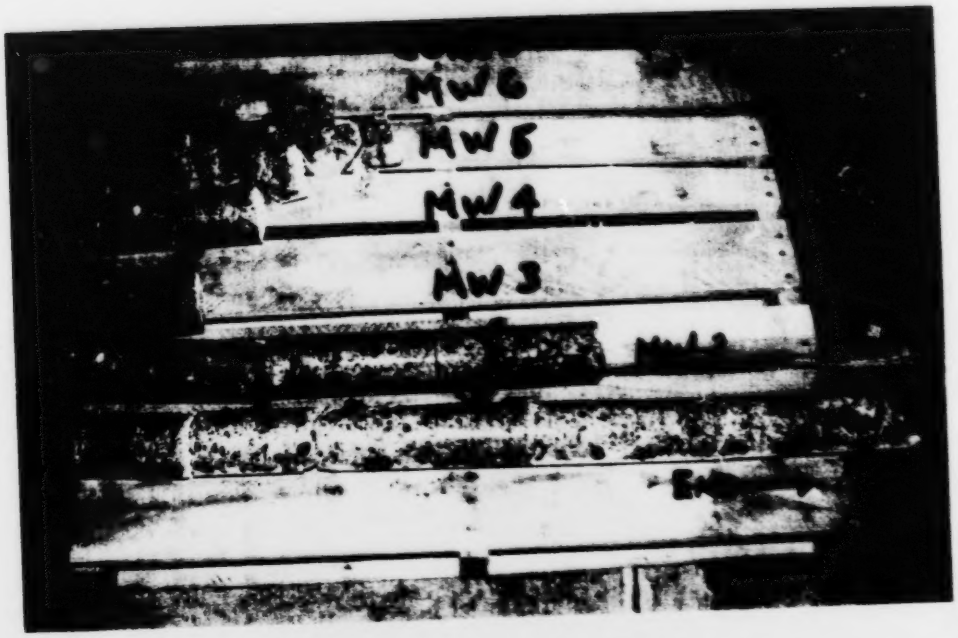


Figure A1 Cores MW1 to MW6 (nominal diameter 100 mm) drilled from the DeCew Falls GS Measuring Weir. For the location of the core holes see Figure 1.